

WHAT IS CLAIMED IS:

1 1. A radio access network which supports plural TCP connections across a radio
2 interface with a user equipment unit (UE), the radio access network comprising:

3 at least one base station node which communicates across the radio interface
4 with the user equipment unit (UE);

5 a radio network control node (RNC) connected to the base station node for
6 controlling the base station node;

7 a radio link control (RLC) entity which processes RLC protocol data units
8 obtained from a medium access control (MAC) layer to obtain Internet Protocol (IP)
9 packets for the plural TCP connections, and which uses availability of Internet Protocol
10 (IP) packets for a given TCP connection to control separately for the given TCP
11 connection in-sequence delivery to an Internet Protocol layer of Internet Protocol (IP)
12 packets without regard to availability of Internet Protocol (IP) packets of another of the
13 plural TCP connections.

1 2. The apparatus of claim 1, wherein, to control in-sequence delivery of the
2 Internet Protocol (IP) packets for the given TCP connection, the radio link control
3 (RLC) entity uses port-specific sequence numbers in the RLC protocol data units which
4 carry the Internet Protocol (IP) packets for the given TCP connection.

1 3. The apparatus of claim 2, wherein the port-specific sequence numbers are
2 carried in an extension of a length indicator field of a header of the RLC protocol data
3 units.

1 4. The apparatus of claim 3, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the port-
3 specific sequence numbers are carried in an extension of a length indicator field of the
4 header of the RLC protocol data units.

1 5. The apparatus of claim 2, wherein the radio link control (RLC) entity
2 maintains a differentiated buffering technique for the plural TCP connections, the
3 differentiated buffering technique involving differentiating between Internet Protocol
4 (IP) packets in accordance with TCP port identifiers carried in the Internet Protocol (IP)
5 packets to form TCP-specific subsets of Internet Protocol (IP) packets.

1 6. The apparatus of claim 5, wherein the differentiated buffering technique
2 involves storing the TCP-specific subsets of Internet Protocol (IP) packets of the plural
3 TCP connections in respective plural buffers.

1 7. The apparatus of claim 5, wherein within each TCP-specific subset the radio
2 link control (RLC) entity orders the Internet Protocol (IP) packets in accordance with
3 the port-specific sequence numbers carried in the RLC protocol data units.

1 8. The apparatus of claim 7, wherein for the given TCP connection the radio link
2 control (RLC) entity delivers to the Internet Protocol (IP) layer Internet Protocol (IP)
3 packets belonging to the given TCP connection which become in-sequence upon arrival
4 of a most recent Internet Protocol (IP) packet belonging to the given TCP connection.

1 9. The apparatus of claim 1, wherein upon obtaining a received Internet Protocol
2 (IP) packet from the Internet Protocol layer for the given TCP connection, the radio link
3 control (RLC) entity updates a port-specific sequence number counter associated with
4 the given TCP connection and includes an updated value of the port-specific sequence
5 number counter along with the received Internet Protocol (IP) packet in a RLC protocol
6 data unit prepared by the radio link control (RLC) entity for transmission to the medium
7 access control (MAC) layer.

1 10. The apparatus of claim 9, wherein the updated value of the port-specific
2 sequence number counter is carried in an extension of a length indicator field of a
3 header of the RLC protocol data units.

1 11. The apparatus of claim 10, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the
3 updated value of the port-specific sequence number is carried in an extension of a
4 length indicator field of the header of the RLC protocol data units.

1 12. The apparatus of claim 1, wherein the radio link control (RLC) entity is
2 situated in a node of the radio access network.

1 13. The apparatus of claim 12, wherein the radio link control (RLC) entity is
2 situated in the radio network control (RNC) node of the radio access network.

1 14. A radio link control (RLC) entity for use with or in a radio access network
2 and which supports plural TCP connections across a radio interface, the radio link
3 control (RLC) entity processing RLC protocol data units obtained from a medium
4 access control (MAC) layer to obtain Internet Protocol (IP) packets for the plural TCP
5 connections, and using availability of Internet Protocol (IP) packets for a given TCP
6 connection to control separately for the given TCP connection in-sequence delivery to
7 an Internet Protocol layer of Internet Protocol (IP) packets without regard to availability
8 of Internet Protocol (IP) packets of another of the plural TCP connections.

1 15. The apparatus of claim 14, wherein, to control in-sequence delivery of the
2 Internet Protocol (IP) packets for the given TCP connection, the radio link control
3 (RLC) entity uses port-specific sequence numbers in the RLC protocol data units which
4 carry the Internet Protocol (IP) packets for the given TCP connection.

1 16. The apparatus of claim 15, wherein the port-specific sequence numbers are
2 carried in an extension of a length indicator field of a header of the RLC protocol data
3 units.
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1 17. The apparatus of claim 16, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the port-
3 specific sequence numbers are carried in an extension of a length indicator field of the
4 header of the RLC protocol data units.

1 18. The apparatus of claim 15, wherein the radio link control (RLC) entity
2 maintains a differentiated buffering technique for the plural TCP connections, the
3 differentiated buffering technique involving differentiating between Internet Protocol
4 (IP) packets in accordance with TCP port identifiers carried in the Internet Protocol (IP)
5 packets to form TCP-specific subsets of Internet Protocol (IP) packets.

1 19. The apparatus of claim 18, wherein the differentiated buffering technique
2 involves storing the TCP-specific subsets of Internet Protocol (IP) packets of the plural
3 TCP connections in respective plural buffers.

1 20. The apparatus of claim 18, wherein within each TCP-specific subset the
2 radio link control (RLC) entity orders the Internet Protocol (IP) packets in accordance
3 with the port-specific sequence numbers carried in the RLC protocol data units.

1 21. The apparatus of claim 20, wherein for the given TCP connection the radio
2 link control (RLC) entity delivers to the Internet Protocol (IP) layer Internet Protocol
3 (IP) packets belonging to the given TCP connection which become in-sequence upon
4 arrival of a most recent Internet Protocol (IP) packet belonging to the given TCP
5 connection.

1 22. The apparatus of claim 14, wherein upon obtaining a received Internet
2 Protocol (IP) packet from the Internet Protocol layer for the given TCP connection, the
3 radio link control (RLC) entity updates a port-specific sequence number counter
4 associated with the given TCP connection and includes an updated value of the port-
5 specific sequence number counter along with the received Internet Protocol (IP) packet
6 in a RLC protocol data unit prepared by the radio link control (RLC) entity for
7 transmission to the medium access control (MAC) layer.

1 23. The apparatus of claim 22, wherein the updated value of the port-specific
2 sequence number counter is carried in an extension of a length indicator field of a
3 header of the RLC protocol data units.

1 24. The apparatus of claim 23, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the
3 updated value of the port-specific sequence number is carried in an extension of a
4 length indicator field of the header of the RLC protocol data units.

1 25. The apparatus of claim 14, wherein the radio link control (RLC) entity is
2 situated in a node of the radio access network.

1 26. The apparatus of claim 14, wherein the radio link control (RLC) entity is
2 situated in a radio network control (RNC) node of the radio access network.

1 27. The apparatus of claim 14, wherein the radio link control (RLC) entity is
2 situated in a user equipment unit (UE) which communicates across the radio interface
3 with a node of the radio access network.

1 28. A user equipment unit (UE) which communicates across a radio interface
2 with a node of a radio access network, the user equipment unit (UE) comprising:
3 a receiver/transmitter which operates in a physical layer;
4 a radio link control (RLC) entity which supports plural TCP connections across a
5 radio interface, the radio link control (RLC) entity processing RLC protocol data units
6 obtained from the medium access control (MAC) layer to obtain Internet Protocol (IP)
7 packets for the plural TCP connections, and using availability of Internet Protocol (IP)
8 packets for a given TCP connection to control separately for the given TCP connection
9 in-sequence delivery to an Internet Protocol layer of Internet Protocol (IP) packets
10 without regard to availability of Internet Protocol (IP) packets of another of the plural
11 TCP connections.

1 29. The apparatus of claim 28, wherein, to control in-sequence delivery of the
2 Internet Protocol (IP) packets for the given TCP connection, the radio link control
3 (RLC) entity uses port-specific sequence numbers in the RLC protocol data units which
4 carry the Internet Protocol (IP) packets for the given TCP connection.

1 30. The apparatus of claim 29, wherein the port-specific sequence numbers are
2 carried in an extension of a length indicator field of a header of the RLC protocol data
3 units.

1 31. The apparatus of claim 30, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the port-
3 specific sequence numbers are carried in an extension of a length indicator field of the
4 header of the RLC protocol data units.

1 32. The apparatus of claim 29, wherein the radio link control (RLC) entity
2 maintains a differentiated buffering technique for the plural TCP connections, the
3 differentiated buffering technique involving differentiating between Internet Protocol
4 (IP) packets in accordance with TCP port identifiers carried in the Internet Protocol (IP)
5 packets to form TCP-specific subsets of Internet Protocol (IP) packets.

1 33. The apparatus of claim 32, wherein the differentiated buffering technique
2 involves storing the TCP-specific subsets of Internet Protocol (IP) packets of the plural
3 TCP connections in respective plural buffers.

1 34. The apparatus of claim 32, wherein within each TCP-specific subset the
2 radio link control (RLC) entity orders the Internet Protocol (IP) packets in accordance
3 with the port-specific sequence numbers carried in the RLC protocol data units.

1 35. The apparatus of claim 34, wherein for the given TCP connection the radio
2 link control (RLC) entity delivers to the Internet Protocol (IP) layer Internet Protocol
3 (IP) packets belonging to the given TCP connection which become in-sequence upon
4 arrival of a most recent Internet Protocol (IP) packet belonging to the given TCP
5 connection.

1 36. The apparatus of claim 28, wherein upon obtaining a received Internet
2 Protocol (IP) packet from the Internet Protocol layer for the given TCP connection, the
3 radio link control (RLC) entity updates a port-specific sequence number counter
4 associated with the given TCP connection and includes an updated value of the port-
5 specific sequence number counter along with the received Internet Protocol (IP) packet
6 in a RLC protocol data unit prepared by the radio link control (RLC) entity for
7 transmission to the medium access control (MAC) layer.

1 37. The apparatus of claim 36, wherein the updated value of the port-specific
2 sequence number counter is carried in an extension of a length indicator field of a
3 header of the RLC protocol data units.

1 38. The apparatus of claim 37, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the
3 updated value of the port-specific sequence number is carried in an extension of a
4 length indicator field of the header of the RLC protocol data units.

1 39. A method of handling plural TCP connections existing across a radio
2 interface, the method comprising:
3 processing RLC protocol data units obtained from a medium access control
4 (MAC) layer to obtain Internet Protocol (IP) packets for the plural TCP connections;

5 using availability of Internet Protocol (IP) packets for a given TCP connection to
6 control separately for the given TCP connection in-sequence delivery to an Internet
7 Protocol layer of Internet Protocol (IP) packets without regard to availability of Internet
8 Protocol (IP) packets of another of the plural TCP connections.

1 40. The method of claim 39, wherein, to control in-sequence delivery of the
2 Internet Protocol (IP) packets for the given TCP connection, the method further
3 comprises using port-specific sequence numbers in the RLC protocol data units which
4 carry the Internet Protocol (IP) packets for the given TCP connection.

1 41. The method of claim 40, wherein the port-specific sequence numbers are
2 carried in an extension of a length indicator field of a header of the RLC protocol data
3 units.

1 42. The method of claim 41, wherein a predetermined value in a header
2 extension type field of the header of the RLC protocol data units indicates that the port-
3 specific sequence numbers are carried in an extension of a length indicator field of the
4 header of the RLC protocol data units.

1 43. The method of claim 40, further comprising maintaining a differentiated
2 buffering technique for the plural TCP connections, the differentiated buffering
3 technique involving differentiating between Internet Protocol (IP) packets in
4 accordance with TCP port identifiers carried in the Internet Protocol (IP) packets to
5 form TCP-specific subsets of Internet Protocol (IP) packets.

1 44. The method of claim 43, wherein the differentiated buffering technique
2 comprises storing the TCP-specific subsets of Internet Protocol (IP) packets of the
3 plural TCP connections in respective plural buffers.

1 45. The method of claim 43, further comprising ordering within each TCP-
2 specific subset the Internet Protocol (IP) packets in accordance with the port-specific
3 sequence numbers carried in the RLC protocol data units.

1 46. The method of claim 45, further comprising for the given TCP connection
2 delivering, to the Internet Protocol (IP) layer, Internet Protocol (IP) packets belonging

- 3 to the given TCP connection which become in-sequence upon arrival of a most recent
4 Internet Protocol (IP) packet belonging to the given TCP connection.

1 47. The method of claim 39, wherein upon obtaining a received Internet Protocol
2 (IP) packet from the Internet Protocol layer for the given TCP connection, the method
3 further comprises updating a port-specific sequence number counter associated with the
4 given TCP connection and includes an updated value of the port-specific sequence
5 number counter along with the received Internet Protocol (IP) packet in a RLC protocol
6 data unit prepared by the radio link control (RLC) entity for transmission to the medium
7 access control (MAC) layer.

1 48. The method of claim 47, further comprising carrying the updated value of
2 the port-specific sequence number counter in an extension of a length indicator field of
3 a header of the RLC protocol data units.

1 49. The method of claim 48, further comprising using a predetermined value in a
2 header extension type field of the header of the RLC protocol data units to indicate that
3 the updated value of the port-specific sequence number is carried in an extension of a
4 length indicator field of the header of the RLC protocol data units.